



Delivery of sustainable supply of non-food biomass to support a
“resource-efficient” Bioeconomy in Europe

S2Biom Project Grant Agreement n°608622

D8.4
R&D roadmap for lignocellulosic biomass in Europe
November 2016



About S2Biom project

The S2Biom project - Delivery of a sustainable supply of non-food biomass to support a “resource-efficient” Bioeconomy in Europe – supports, characterises and quantifies the sustainable delivery of non-food biomass feedstock at local, regional and pan European level through developing strategies and roadmaps that will be informed by a “computerised and easy to use” toolset with updated and harmonised datasets at local, regional, national and pan European level for EU28, western Balkans, Turkey and Ukraine. Further information about the project and the partners involved are available under www.s2biom.eu.

Project coordinator



Scientific coordinator



Project partners



About this document

This report corresponds to 'D8.4 Roadmap for lignocellulosic biomass in Europe'. It has been prepared by:

Calliope Panoutsou, Imperial College London; Berien Elbersen, DLO Alterra and Ludger Wenzelides, Birger Kerckow – FNR, Fachagentur Nachwachsende Rohstoffe

This project is co-funded by the European Union within the 7th Framework Programme. Grant Agreement n°608622. The sole responsibility of this publication lies with the author. The European Union is not responsible for any use that may be made of the information contained therein.

Table of contents

Summary	4
Aim of the Roadmap	5
Setting the scene	6
R&D priorities for lignocellulosic biomass to supply bioenergy and biobased materials by 2030	8
A. Mobilising agricultural, forestry and waste biomass through the development of sustainable supply chains	9
Mapping of current R&D on lignocellulosic biomass in Europe	9
Gaps in research knowledge	9
B. Providing evidence based information on competition for resources (including land and water)	12
Mapping current R&D	12
Gaps in research knowledge	12
C. Informing policy formation and updates at European, national, regional and local level	14
Mapping of current R&D on lignocellulosic biomass in Europe	14
Gaps in research knowledge	14
Concluding remarks	16
ANNEX I: Research projects for sustainable supply and delivery of lignocellulosic biomass	17

Summary

S2Biom (www.s2biom.eu), a European funded project, improved scientific evidence on the availability, cost supply, technologies and framework conditions (policy, financing, sustainability) for lignocellulosic non-food biomass in Europe¹ by 2030.

This report outlines a research and development roadmap for sustainable biomass supply and delivery at pan European level to promote and develop environmentally desirable bioenergy and bio-based materials.

The roadmap and the information provided represents the collective assessments made within this project and the ones it has interfaced with (BEE, CEUBIOM, Biomass futures, Biomass Policies, Biomass Trade Centres, Sector and Bioboost) as well as the experience of the multi-disciplinary, interregional team and reflects the discussions and exchange of opinion with stakeholders during the course of the project.

¹ EU28, Western Balkans, Moldova, Ukraine, Turkey

Aim of the Roadmap

The roadmap developed within S2Biom aims to provide recommendations, prioritise them and further suggest support mechanisms to achieve the goals established by the European Commission and its neighbouring country research priorities.

As a document, it is expected to:

- provide evidence- based support for European countries and the Commission to define future research priorities;
- inform national and regional action plans regarding future research on lignocellulosic biomass;
- increase awareness among the scientific community and decision makers.

Setting the scene

The specific research objective in Horizon 2020 is to develop a resource efficient economy that is resilient to climate change, together with a supply of raw materials, to meet the needs of a growing global population within the sustainable limits of the planet's natural resources.

Horizon 2020 also defines sustainable development as an overarching objective and within that six main social challenges to which research, development and innovation should respond.

Bioeconomy, including bioenergy and bio-based industries are strongly coherent with the overall goal of sustainable development because biomass resources when properly managed are renewable and therefore potentially sustainable. Use of bio-resources and conversion to energy and products can contribute to some extent to each of the six grand challenges.

While the importance of bioeconomy for bioenergy and bio-based materials has high priority both in policy, industry and research, there is still an intensifying debate about the extent of the potential impacts on food security, land use and potential trade-offs among competing uses. These are likely to improve only with technological advance and innovation including the increased mobilisation of lignocellulosic biomass².

So far, the main resources used in innovative bio-based value chains derive from oil, sugar and starch crops. Therefore, substantial research should be performed to bring lignocellulosic biomass closer to industry and increase its market uptake.

The structure of the European lignocellulosic biomass supply industry is quite diverse in terms of feedstock types, availability, quality and cost. S2Biom has advanced scientific knowledge around these issues by estimating the sustainable potential of fifty feedstock types across thirty-seven European countries with the same methodological approaches and making this knowledge publicly available. Based on the project results, the respective annual sustainable potential in Europe is substantial while in most of the EU Member States climate, water and soil conditions are favourable.

As stated in the S2Biom Vision (Deliverable 8.2) to ensure efficient market development for the future lignocellulosic based bioeconomy, the establishment of efficient, cost-effective supply chains, providing raw materials of known and consistent quality will be essential. Future research work on lignocellulosic biomass resources and sustainability should:

- Develop knowledge for yield improvements and new cropping systems and improve understanding of the biomass composition.
- Develop clear and specific roadmaps with concrete steps and impact quantification.
- Understand the local context under which the measures would be best suited and adapt to local needs and infrastructures.

² Ex-ante impact assessment for the Biobased JTI, Dr Nigel Lucas.

- Develop common set of definitions and indicators as well as employ bottom up methodologies to facilitate information for policy.
- Improve policy narratives and set clear visions.

These matters require important, coherent and coordinated actions in future research. The Roadmap presented here, following discussions among partners and selected stakeholders of the Policy and Industry Advisory Committee has further grouped them in three steps, presented in detail in the sections below:

- mobilising agricultural, forestry and biowaste lignocellulosic resources through the development of sustainable supply chains;
- providing evidence based information regarding competition for resources (including land and water);
- informing policy formation and updates at European, national, regional and local level.

R&D priorities for lignocellulosic biomass to supply bioenergy and biobased materials by 2030

The Roadmap is based on the experience of the multi-disciplinary, interregional S2Biom team and reflects the discussions and exchange of opinion with stakeholders as well as the Vision document sections for improving knowledge and access to available information for biomass resources and sustainability. Work performed in S2Biom highlighted that a key issue for the future is to continue building up a concise knowledge base, focus and further tailor research and demonstration activities for:

- mobilising agricultural, forestry and biowaste lignocellulosic resources through the development of sustainable supply chains;
- providing evidence based information regarding competition for resources (including land and water);
- informing policy formation and updates at European, national, regional and local level.

Figure 1 below presents the Roadmap steps.

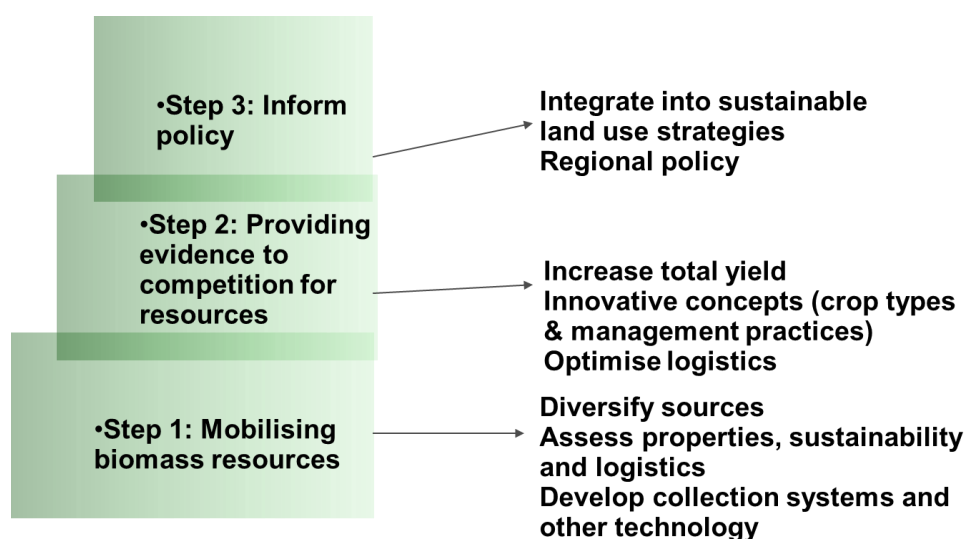


Figure 1 R&D roadmap for lignocellulosic biomass: Three Steps Forward

The following sections present detailed information for each of the three identified R&D roadmap steps in terms of:

- Mapping past, and ongoing research projects in the field of lignocellulosic biomass supply, logistics and respective policies and further group them to specific topics where appropriate. Detailed information about the projects can be found in Annex I.
- Identifying gaps in research knowledge
- Detailing a table per roadmap step with each priority, the respective timeline for research and indicative funding schemes which could be applied for future support.

A. Mobilising agricultural, forestry and waste biomass through the development of sustainable supply chains

Despite the technical availability of lignocellulosic biomass, its mobilisation at regional level remains a key constraint especially in the agricultural and biowaste sectors. S2Biom provides a set of suggested R&D priorities which will capitalise on past research and facilitate knowledge development and subsequent mobilisation and market uptake.

Mapping of current R&D on lignocellulosic biomass in Europe

Based on the review conducted within S2Biom, research funded so far in this area can be grouped in the following categories:

- non-food crop species (sustainably increasing yields, feedstock quality, genetics and environmental impacts);
- using marginal and degraded lands;
- improved agricultural practices;
- improved forestry practices;
- develop large-scale logistics, including harvesting, storage and transport to providing continuous supply of sustainable feedstocks to plant gates; and
- adaptation to and mitigation of climate change.

Gaps in research knowledge

The main gaps in knowledge for mobilising biomass and developing sustainable supply chains can be summarised as follows:

- R&D on non-food crops for achieving low input but good yields on unused, marginal, low quality, abandoned lands in Europe;
- ecological intensification of agriculture – matching crops to the ecological and climatic zones, optimising and recycling nutrients and water, new pest and disease control techniques;
- using intercropping as a technique to optimise yields on a given land (e.g. using legume crops for improving yields);
- multifunctional agro-forestry - combining agricultural and forestry best practices to create diverse, productive, profitable, healthy and sustainable land-use system;

- assessment of potential, collection, logistics, economics and environmental impact of crop residues, wood and wood-processing residues, and food-processing residues.

Table 1 provides a set of R&D priorities for mobilising biomass and developing supply chains and Figure 2 provides an overall graphic presentation for all R&D roadmap steps.

Table 1 R&D priorities for mobilising biomass and developing supply chains

Priority ³	Term ⁴		Funding scheme ⁵
Sustainable feedstock production			
Medium	Sh	Low input cropping systems suitable to marginal, low quality, abandoned lands in Europe	R&D D
High	Sh L	Ecological intensification of agriculture – matching crops to the ecological and climatic zones, optimising and recycling nutrients and water, new pest and disease control techniques	R&D CSA D
Medium	L	Multifunctional agro-forestry - combining agricultural and forestry best practices to create diverse, productive, profitable, healthy and sustainable land-use system	R&D D
High	Sh L	Improve collection, sorting and handling of various biowaste streams	D
Medium	L	Improve the yielding potential of crops, their fuel characteristics as well as their resistance to biotic and abiotic stresses through modern tools of biotechnology	
High	L	Addressing social constraints to biomass mobilisation – study owner attitudes, identify main obstacles to biomass mobilisation and develop business models for biomass cooperatives targeting small land owners and fragmented resource situations	R&D, D
Harvesting/ Collection/ Storage			
High	Sh L	Develop harvesting and collection systems (new equipment, new chains) to maximise supply by minimizing costs per unit.	R&D D
Medium	Sh L	Assessment of potential, collection, logistics, economics and environmental impact of crop residues, wood and wood-processing residues, and food-processing residues	R&D CSA D
Low	Sh	Develop feedstock quality and monitoring systems both for wet and for dry storage.	R&D D
High	L	Increase the efficiency of logistics over longer distances in the future by developing and testing technology and supply chains.	Demonstration / R&D

³ High, Medium, Low

⁴ Short- term (Sh), Long- term (L)

⁵ Demonstration, R&D, CSA: Coordination/ Support Action

Medium	L	Boost the process of terminal establishment by assessing legal prerequisites, optimal technology and location.	R&D / CSA
High	L	Integrate biomass value chains with other value chains (e.g. integrated harvesting of residues & the main product(s), new alternatives for backhauling, multiple-use machines to alleviate seasonal fluctuations)	Demonstration / R&D

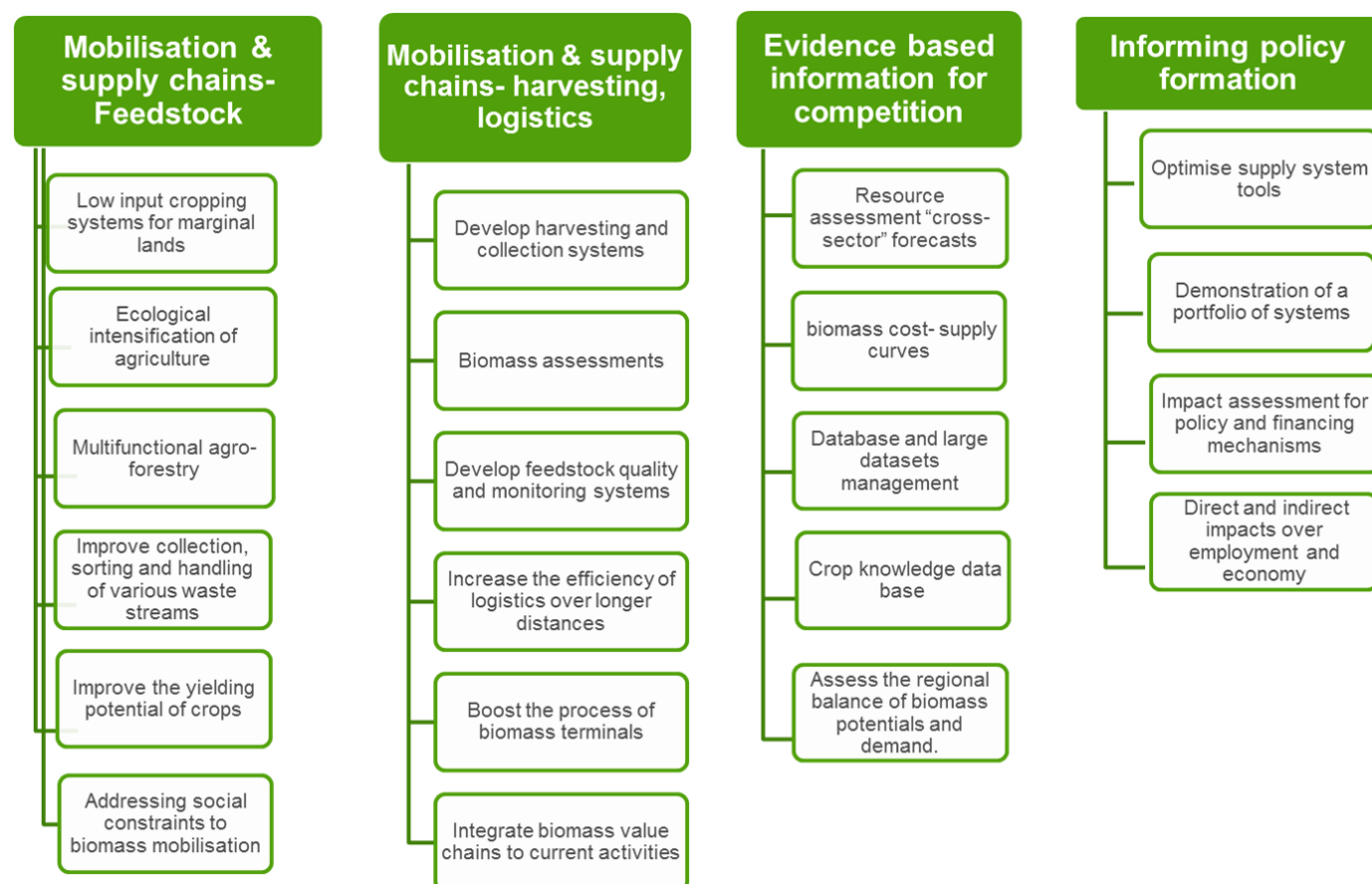


Figure 2 R&D priorities for lignocellulosic biomass supply, harvesting, logistics and policy

B. Providing evidence based information on competition for resources (including land and water)

Mapping current R&D

Based on the review conducted within S2Biom, research funded so far in this area focused on assessments of biomass potentials at different implementation levels addressing various assumptions for displacement effects at different temporal resolutions (covering a period from 2000-2030).

S2Biom provides a set of suggested R&D priorities which will capitalise on past research and improve evidence on competition for resources.

Gaps in research knowledge

The main gaps in knowledge for providing evidence based information to competition for resources can be summarised as follows:

- Harmonised and complete datasets
- Crop knowledge data base on SRC/SRF and energy grasses, including yields, farming practices and agro-environmental impact (GHG emissions, water, biodiversity, etc.)
- Quantification and integrated modelling at EU and national level considering all land use sectors and uses of biomass (food, feed, fiber, fuel + biomaterials and green chemistry)
- Assessments of the most efficient use of biomass resources for the different competing uses

Table 2 provides a set of R&D priorities for mobilising biomass and developing supply chains and Figure 2 provides an overall graphic presentation.

Table 2 R&D priorities for providing evidence based information to competition for resources

Priority ⁶	Term ⁷		Funding scheme ⁸
Resource assessment/ forecasting			
High Medium	L	Resource assessment “cross- sector” forecasts/ monitoring guidelines in relation to resource efficiency, cascading factors, competition for land use and implementation level (top down & bottom up)	R&D D
High	L	Develop biomass cost- supply curves in relation to cascading factors, costs and life cycle analysis.	R&D CSA D
High Medium	Sh	Database and large datasets management	R&D CSA D
		Crop knowledge data base including yields, farming practices and agro-environmental impact (GHG emissions, water, biodiversity...)	
		Feedstock quality data (physical and chemical) both for dry and wet biomass in relation to diverse end use options and post-harvest operations such as size reduction, densification, blending, etc.	
High	Sh	Locate the “hot spots” of bioenergy. Assess the regional balance of biomass potentials and demand. Regions where the demand of heat is large compared to biomass potential are most suitable for heating or CHP installations whereas regions with abundant biomass resources compared to demand might be suitable for biofuel production. The idea would be to match biomass potentials with the best local solution. Other than energy demand should be included, too.	R&D

⁶ High, Medium, Low

⁷ Short- term (Sh), Long- term (L)

⁸ Demonstration, R&D, Coordination/ Support Action

C. Informing policy formation and updates at European, national, regional and local level

Policy formation for biomass supply and logistics still requires consistent efforts which should be aligned with the feedstock types and their sustainable management as well as with rural development, sustainability and nature preservation priorities.

S2Biom provides a set of suggested R&D priorities which will capitalise on past research and inform policy formation at different implementation levels.

Mapping of current R&D on lignocellulosic biomass in Europe

Based on the review conducted within S2Biom, research funded so far in this area can be grouped in the following categories:

- regional bioenergy planning and mobilising biomass from agriculture and forestry in a resources efficient way along the supply chain;
- addressing socio-economic and environmental sustainability of biomass feedstocks;
- standardisation and certification issues;
- promoting market uptake for biomass.

Gaps in research knowledge

The main gaps in knowledge for informing policy formation and updates at European, national, regional and local level can be summarised as follows:

- Comparison of the efficiency of different existing support schemes for biomass feedstock mobilisation at EU/National/Regional/Local levels;
- understanding motivations and decision making among farmers and forest owners in Europe as a basis for improved policy approaches;
- understanding of the economic, social and environmental impacts of large-scale biomass feedstock systems;
- intra-trade issues and imports
- LCA of different biomass supply chains incorporating not only GHG, but also considering water use, biodiversity, land-use change and socio-economic factors.

Table 3 provides a set of R&D priorities for mobilising biomass and developing supply chains and Figure 2 provides an overall graphic presentation.

Table 3 R&D priorities for informing policy formation and updates at European, national, regional and local level

Priority ⁹	Term ¹⁰		Funding scheme ¹¹
System analysis			
Medium	Sh	Optimise supply system tools taking into account various land use, resource efficiency, displacement effects, market interdependencies, etc.	R&D D
High Medium	Sh L	Demonstration of a portfolio of systems (subject to regional ecology and climate) with high potential for feedstock supply in relation to availability, infrastructure and supportive policy framework.	CSA D
Medium Low	Sh L	Supply and demand analysis and impacts for policy and financing mechanisms (local, regional level).	R&D CSA D
High Medium	Sh L	Best practices, mobilisation, benchmarking	CSA D
High	Sh	Analysis and estimation of direct and indirect impacts over employment and economy at regional and national scale from specific value chains and the use/promotion of biofuels	R&D CSA

⁹ High, Medium, Low

¹⁰ Short- term (Sh), Long- term (L)

¹¹ Demonstration, R&D, Coordination/ Support Action

Concluding remarks

Lignocellulosic biomass is an important domestic asset for European countries. It can be feedstock for energy and, in the long run, for bio-based products and materials. It is widely available and well suited to a range of conversion routes and applications.

Nowadays, its market uptake is within traditional energy uses mostly while significant R&D is taking place to ensure compatibility with innovative conversion technologies and integration of supply and logistics with existing infrastructures in the forest, agriculture and biowastes industries.

The future development of a lignocellulosic bioeconomy will require:

- alignment of the various research funding streams to ensure system integration for the research outputs and avoid overlapping;
- long term consistency in R&D funding both in terms of budget and appropriately focused topics that will be oriented towards mobilising and integrating the European feedstocks into day to day operations of the respective industries;
- monitoring past and current activities and building on these to ensure that European researchers, their work and infrastructures are appropriately acknowledged and future research priorities capitalise on the knowledge generated so far.

Based on the above, this Roadmap suggests several research priorities that could be considered in the future by the various funding bodies and policy making institutions.

ANNEX I: Research projects for sustainable supply and delivery of lignocellulosic biomass

Table 4 RESEARCH AND DEVELOPMENT PROJECTS AND PRIORITIES FOR SUSTAINABLE SUPPLY OF BIOMASS FEEDSTOCK

Research area	Projects
Non-food crops (sustainably increasing yields and feedstock quality)	Mobilising agricultural, forestry and waste biomass through the development of sustainable supply chains
	<u>NUE-CROPS</u> - <u>Improving nutrient efficiency</u> in major European food, feed and biofuel crops to reduce the negative environmental impact of crop production (FP7 KBBE-2007-1-2-15 Reducing the utilisation of mineral fertilisers by improving the efficiency of nutrient use in European crops)
	<u>RENEWALL</u> : <u>Improving Plant Cell Walls for Use as a Renewable Industrial Feedstock</u> . (KBBE-2007-3-1-01 Plant Cell Walls - Understanding Plant Cell Walls for optimizing Biomass potential)
	<u>NOVELTREE</u> <u>Novel tree breeding strategies</u> to enable significant genetic improvement of the composition and characteristics of forest products to satisfy the needs (quality, quantity, sustainability, vulnerability) of consumers and the forest-based sector. (FP7 KBBE-2007-1-2-05 Novel forest tree breeding)
	<u>ENERGYPOPLAR</u> : <u>Enhancing Poplar Traits for Energy Applications</u> . The project will develop domesticated energy poplars having both desirable cell-wall traits and high biomass yield under sustainable low-input conditions to be used as a source of lignocellulosic feedstock for bioethanol. (KBBE-2007-3-1-02 Energy Plants - Novel plants for energy production)
	<u>ENERGY PLANTS</u> - <u>Novel plants</u> for energy production (CP-FP). (FP7 KBBE-2007-3-1-02 ENERGY PLANTS - Novel plants for energy production)
	<u>JATROPT</u> : <u>Jatropha curcas – breeding strategy</u> – towards a sustainable crop for biomaterials and biofuels (CP-FP-SICA-India, Africa and Latin America) (FP7 KBBE-2009-3-1-02 Jatropha curcas - breeding strategy - towards a sustainable crop for biomaterials and biofuels - SICA (India and/or African ACP and/or Latin America))
	<u>FORGER</u> - Towards <u>sustainable management of forest genetic resources</u> – <i>under negotiation</i> (FP7 KBBE.2011.1.1-04: Sustaining and managing forest tree genetic resources)
	FP7 KBBE.2011.3.1-02: <u>Perennial grasses</u> : optimisation of biomass production CP-FP targeted to SMEs – SICA OPTIMISC – Optimising Miscanthus Biomass Production; The project aims to develop miscanthus as a major biomass crop in Europe https://optimisc.uni-hohenheim.de/

Research area	Projects
	OPTIMA - Optimization of Perennial Grasses for Biomass Production; to identify high-yielding perennial grasses for the Mediterranean area, within optimized production chain that will provide stable source for both biomass and new plant derived bio-products http://www.optima7.eu/ Grassmargins - Enhancing biomass production from marginal lands with perennial grasses http://www.grassmargins.com/
	BIOSEA - Improving the efficiency in cultivation of crops destined to energy chains; enlarging the knowledge regarding genetic variability on “new” crops; <u>identification of high-productive genotypes</u> ; evaluation of the technological quality of biomasses; evaluation of economic aspects related to agroenergy chains, as well as to their competitions towards food chains; environmental impact analysis, territorial analysis (GIS); analysis of mechanization and logistic aspects of the chains (IT – from project mapping exercise)
	Improvement of <u>cultivation and competitiveness of <i>silphium perforiatum</i></u> as energy crop (2 integrated projects) (DE: 22001110/22012809¹)
	FP7 WP2012 KBBE: <u>Multipurpose crops</u> for industrial bio-products and biomass (2 projects, up to €6M)
<u>Using residues for biomass feedstocks</u>	BIOMASSVAL - The project’s aim is to <u>improve the use of agricultural wastes from food crops</u> (tomato, barley, wheat, grapevine) for the production of bioenergy, from the selection of crop varieties to their processing, production of fuel (biogas) and reuse of by-products as fertilizers. 1) identification of barley, tomato and wheat genotypes optimized for the production of both food and energy (Global Harvest Index); 2) development of improved fermenting microorganisms and enzymes for the production of biofuels; 3) evaluation of the by-products of the biofuel production process as fertilizers. (IT – from project mapping exercise)
	GREENRICE - Overall project objective is improving the environmental sustainability of <u>rice productive chain</u> , including <u>use of by-products for energy recovery</u> ; identifying scenarios and solutions enabling a reduction of environmental impacts in a full LCA perspective. greenGain - Supporting Sustainable Energy Production from Biomass from Landscape Conservation and Maintenance Work

Research area	Projects
Improved <u>agricultural practices</u>	<p>WACOSYS The aim of the project was to develop, test and optimise a monitoring and control system for <u>wastewater irrigation of Short Rotation Plantations</u> (SRPs).</p> <p>BIOPROS - Solutions for the safe application of <u>wastewater and sludge</u> for high efficient biomass production in <u>Short-Rotation-Plantations</u> (FP6/SMEs)</p>
	<p>BENWOOD - Coordination Actions in Support Of Sustainable and Eco-Efficient <u>Short Rotation Forestry</u> in CDM/JI Countries (FP7 KBBE-2008-1-2-07 Forest energy - Short rotation forestry as a sustainable and eco-efficient land use management system for fossil fuels substitution within CDM-projects)</p>
	<p>LEGUMEFUTURES - A resource centre is being developed within Legume Futures as a source and repository of information on legumes and <u>legume-based cropping systems</u>. The aim is to reinforce use of legumes in Europe for all the interest they have for agriculture, protein dependence and environment. (FP7 KBBE-2009-1-2-01 Legumes: key multifunctional legume crops for an energy-efficient and environmentally friendly future European agriculture)</p>
	<p>MULTISWARD - Multi-species swards and multi scale strategies for multifunctional grassland-base ruminant production systems – <u>reinforce use of grasses, including use for energy biomass</u> (FP7 KBBE-2009-1-2-02 Multifunctional grasslands for sustainable and competitive ruminant production systems and the delivery of ecosystem services)</p>
	<p>ELKE II Development of <u>low input land use systems</u> for energy production (DE: 22007709ⁱ)</p>
	<p>EVA II Development and comparison of <u>optimised cultivation systems for energy crops</u> under German conditions (different sites, several closely related projects) (DE:22013008/22013108/22013208/22013308/22013408/22013508ⁱ)</p>
	<p>KBBE 2013 Biomass <u>guidelines for growers for optimal land use</u></p>
Using <u>marginal and degraded lands</u>	<p>BIOSAFOR - <u>Biosaline agroforestry</u>: remediation of saline wastelands through the production of biosaline biomass (for bioenergy, fodder and biomaterials) (INCO-2002-A2.3 Managing arid and semi-arid ecosystems)</p>
	<p>FUNCiTree Functional Diversity: An ecological framework for sustainable and adaptable <u>agro-forestry systems</u> in landscapes of <u>semi-arid and arid eco-regions</u> (KBBE-2008-1-2-05 Improved agro-forestry systems for sustainable farming - SICA)</p>

Research area	Projects
	<p>Sustainable bioenergy production on <u>dry sandy soils</u> by increasing biodiversity (cultivation of Bokhara clover) (Germany: 22014107¹)</p> <p>SEEMLA - Sustainable exploitation of biomass for bioenergy from marginal lands</p>
Improved <u>forestry practices</u>	<p>NEWFOREX: New ways to <u>value and market forest externalities</u> (biodiversity, recreation, soil erosion protection, water quality, carbon storage) FP7 KBBE-2009-1-2-06 Developing new methods for valuing and marketing currently non-marketable forest functions, goods and services)</p> <p>ARANGE - <u>Advanced multifunctional forest management in European mountain ranges - under negotiation</u> (FP7 KBBE.2011.1.2-07: Preserving the multifunctionality of European Mountain forests)</p> <p>FP7 WP2012 KBBE: "<u>Multipurpose trees and non-wood forest products</u> for an innovative forestry <u>in rural areas</u>" (1 project)</p> <p>FP7 WP2012 ERA-Net Plus on "<u>Innovation in the forest-based sector</u> for increasing resource efficiency and tackling climate change with competitive customer solutions", FP7 WP2012 KBBE-NMP</p>
Develop large-scale <u>logistics, including harvesting, storage and transport</u> to providing continuous supply of sustainable feedstocks to plant gates	<p>BIOCARD – Global Process to improve <i>Cynara cardunculus</i> exploitation for energy applications. Project assessed existing <u>machines</u> to establish whether they can be modified for thistle cultivation, as well as designed specific prototypes based on the problems found in thistle test plots. P6 SUSTDEV-2004-1.2.5 "Energy from Crops"</p> <p>Up to 3 projects on "<u>Development of new or improved logistics for lignocellulosic biomass harvest, storage and transport</u>" (FP7 WP2012 Energy-KBBE)</p>

Providing evidence based information to competition for resources (including land and water)	
<u>Adaption to and mitigation of climate change</u>	BACCARA - Assesses the impact of climate change on tree species assemblages, rates the risks to forest productivity loss, and provides recommendations; develop a decision-support system aimed at balancing costs and benefits for the establishment of new forest composition in order to anticipate and mitigate the potential detrimental effects of climate changes on forest productivity. (FP7 KBBE-2008-1-2-06 Forecasting forest diversity under the influence of climatic changes and the consequences for stability and productivity of forest ecosystems)
	DOFOCO : Do forests cool the Earth? Reconciling sustained productivity and minimum climate response with portfolios of contrasting forest management strategies. The overall goal of DOFOCO is to quantify and understand the role of forest management in mitigating climate change. (ERC-SG-LS9)
	SmartSOIL - Sustainable farm management aimed at <u>reducing threats to soils under climate change</u> – <i>under negotiation</i>
	CATCH-C - Compatibility of <u>agricultural management practices</u> and types of farming in the EU <u>to enhance climate change mitigation and soil health</u> – <i>under negotiation</i> (Both projects under FP7 KBBE.2011.1.2-01: Sustainable management of agricultural soils in Europe for enhancing food and feed production and contributing to climate change mitigation) FP7-KBBE-2012: "Development of management strategies for planted and managed forests to increase mitigation capacity"
<u>Biomass potential assessments</u>	BEE – Biomass Energy Europe was initiated to <u>harmonise methodologies for biomass resource assessments</u> for energy purposes in Europe and its neighbouring countries. The harmonisation will improve consistency, accuracy and reliability of biomass assessments for energy, which can serve the planning of a transition to renewable energy in the European Union. (FP7 ENERGY-2007-3.7-01 Harmonisation of biomass resource assessment)
	EUBIONET III project aims to increase the use of biomass based fuels in the EU by boosting sustainable and transparent biomass fuel trade, securing the most cost efficient and value-adding use of biomass for energy and industry and identifying yet unexploited biomass fuels. Amongst others: - 54 new types of biomass sources identified (Potential 6.4-7.9); - New industry sectors found for increased biomass use; - The appropriate use of biomass resources will be assessed by analysing competition and price situation of woody biomass use in forest industry

	<p>and energy sector. www.eubionet.net (IEE/07/777 IEE programme)</p>
	<p>Biomass futures assesses the role that biomass can play in meeting EU energy policy targets. It defines the key factors likely to influence biomass supply, demand and uptake over the next twenty years (meeting the RED targets). Among other factors, partners examine the EU heat, electricity-CHP and transport markets; supply and demand dynamics; the effects of indirect land use change, water use and social aspects on future biomass supply, etc. (IEE/08/653 IEE programme)</p>
	<p>CEUBIOM - Classification of European Biomass Potential for Bioenergy Using Terrestrial and Earth Observations The ambition of the project was to develop a Platform and a self-sustained e-service to directly assist and train professionals from the Earth Observation (EO), agricultural and EO/biomass sectors about the <u>new, common and harmonised applications of EO</u> and a better understanding of each other's requirements. (FP7 ENERGY-2007-3.7-01 Harmonisation of biomass resource assessment)</p>
	<p>RECOVER - <u>Science based remote sensing services to support Reducing Emissions from Deforestation and Forest Degradation (REDD)</u> initiative and sustainable forest management in tropical region. Its main research focus is to develop a sound statistical concept and accuracy assessment procedure that enables the generation of more reliable estimates for forest degradation and change, as well as enhanced biomass estimates. (FP7-SPACE-2010-1)</p>
	<p>REDDAF - Reducing Emissions from Deforestation and Degradation in Africa. The services and products that will be delivered to the user community include <u>forest cover maps and forest cover change maps</u> for 1990-2000 and 2000-2009/10 (land use changes based on six IPCC compliant land use classes); degradation maps, biomass maps and the relevant digital datasets. (FP7-SPACE-2010-1)</p>

Informing policy formation and updates at European, national, regional and local level	
Regional bioenergy planning and mobilising biomass from agriculture and forestry in a resources efficient way along the supply chain	<p>Biomass Trade Centres - Project supporting the organization of regional markets for wood fuels, by creating Biomass Logistic & Trade Centres (BLTCs) and improving the professional approach of wood fuels producers, through training activities and demonstration events. The project developed guidelines on how to set up a regional BLTC and successfully BLTCs were set up during the project. (EIE/07/054 IEE programme)</p>
	<p>BiomassTradeCentrell – Follow-on of Biomass Trade Centres project, with the aim objectives of fostering the creation of biomass trade and logistic centres, but also putting effort in promoting the introduction of quality assurance and control systems. (IEE/10/115 IEE programme)</p>
	<p>Wood Heat Solutions The project aimed at <u>mobilising the large biomass potential from unmanaged/under-managed forests for heat production in Croatia, Slovenia and in the UK, by using the exemplar experience from Austria (on wood fuel quality and certification) and Finland (on the entrepreneurship model)</u>. This was done through workshops, training courses, study tours to Austria and Finland, expert support to specific projects. CEN standards for solid biofuels were also disseminated. (IEE/07/726 IEE programme)</p>
	<p>BEn - "Biomass Energy Register for sustainable site development for European Regions" supports <u>local communities energy planning</u> through the development of a GIS <u>regional energy register</u> indicating local energy sinks as well as biomass potentials for energy production, in 4 European regions (North West/UK, Emscherippe/Germany, Pojezierze Gostyninsko-Wloclawskie/Poland and Umbria/Italy). The project also aims at the creation of <u>regional biomass networks</u>, and the development of master plans for sustainable bioenergy planning including guidance for management and financing biomass energy investment, and at the implementation of bioenergy actions in the selected regions. (IEE/07/595 IEE programme-2007-Biobusiness)</p>
	<p>BioEnerGIS – "GIS-based decision support system aimed at a sustainable energetic exploitation of biomass at regional level". This project provides instruments to help decision makers to plan, on a regional scale, the sustainable energy exploitation of biomass. <u>A GIS-based Decision Support System, named BIOPOLE, has been developed to locate the most suitable sites - in terms of energy, environmental, social and economic sustainability - for biomass plants installations</u>. From the results of the application of the tool, the project has searched for the public and private stakeholders interest in developing identified plants. Four regions, representing different environmental and economic zones, have been investigated: Lombardy (Italy), Northern</p>

	<p>Ireland (UK), Slovenia and Wallonia (Belgium). (IEE/07/638 IEE programme-2007-BioBusiness)</p> <p>The MAKE-IT-BE project focuses on the creation and implementation of <u>decision-making tools for local and regional policy makers</u> in 4 EU Regions (in Austria, Italy, Slovenia and UK). These tools are aimed at assisting policy makers in extensively identifying, evaluating and initiating bio-energy chains. Thanks to the implementation of the tools the four EU regions have implemented Bioenergy Agendas with specific bioenergy projects. (IEE/07/722 IEE programme-2007-BioBusiness)</p> <p>Economic and ecologic assessment of agro forestry systems in agricultural practice (Germany: 4 integrated projects: 22004907/22009707/22009807/22009907')</p>
<p><u>Addressing socio-economic and environmental sustainability of biomass feedstocks</u></p>	<p>4F CROPS: Future Crops for Food, Feed, Fibre and Fuel The project surveyed and analysed all the parameters that would play an important role in successful non-food cropping systems in the agriculture of EU27 alongside the existing food crop systems. <u>The cropping possibilities based on regional potential levels, ecology and climate were determined. A comparative cost analysis of non-food and conventional crops was done. Socio-economic impacts, like farmers income, rural development, public development, and public acceptance was analysed. Then environmental implications will be assessed compared to their respective conventional products</u> (fossil energy, conversional materials) (WP4). (KBBE-2007-3-1-07: FUTURE CROPS - Technical, socio-economic, environmental and regulatory aspects of future non-food crop systems)</p> <p>CROPS2INDUSTRY: Non-Food Crops-to-Industry schemes in EU27. The objectives of this project are the following: <u>Explore the potential of non-food crops</u>, which can be domestically grown in EU27 countries, for selected industrial applications, namely oils, fibers, resins, pharmaceuticals and other specialty products (WP1); <u>Identify current molecular genetics technologies</u> (genomic and biotechnological tools) and suggest their potential applications in a crop-specific manner <u>to address a wide range of breeding constraints regarding yields and tolerance to abiotic and biotic conditions</u> (WP2); Explore the potential and feasibility of the European industry to make high-value biobased products from renewable agriculture and forestry feedstocks and biotechnological routes (WP3); Perform <u>supply chain cost analysis, identify best business opportunities and assess the socio-economic impacts of selected crop-to-product schemes at EU-27, regional and country levels</u> (WP4); Assess selected production and environmental impacts and identify a 'core' list of standards and criteria for the environmental and socio-economic sustainability of selected non-food crops-to-industrial-products systems (WP5); Perform an overall assessment</p>

	<p>aiming to select and prioritise crops-to-products schemes in technical, socio-economic and environmental terms (WP6) (FP7 KBBE-2008-3-1-03 - European non-food crops and their industrial application. Coordination and support action.)</p> <p>Global-Bio-Pact: (KBBE-2009-3-4-01) The objective of the Global-Bio-Pact project is <u>the development and harmonization of global sustainability certification systems for biomass production, conversion systems and trade in order to prevent negative socio-economic impacts</u>. Emphasis is placed on a <u>detailed assessment of the socio-economic impacts of raw material production and a variety of biomass conversion chains</u>. The impact of biomass production on global and local food security and the links between environmental and socio-economic impacts is analysed. Furthermore, the Global-Bio-Pact project investigates the impact of biomass production on food security and the interrelationship of global sustainability certification systems with the international trade of biomass and bioproducts as well as with the public perception of biomass production for industrial uses. Finally, Global-Bio-Pact develops a set of socio-economic sustainability criteria and indicators for inclusion into a future effective certification scheme, and the project elaborates recommendations on how to best integrate socio-economic sustainability criteria in European legislation and policies on biomass and bioproducts.</p> <p>POPFULL The objectives of the POPFULL project are: (i) to make a full balance of the most important greenhouse gases (CO₂, CH₄, N₂O, H₂O and O₃), (ii) to make a full energy and economic accounting; and (iii) <u>to perform a full life cycle analysis (LCA) of the global warming contribution of SRC</u>. The overall energy efficiency of the system will be assessed. (ERC-AG-LS9)</p> <p>ELOBIO assessed the impacts of growing demand for bioenergy on other markets (food, commodities), as well as the possible resulting ILUC effects. (EIE/07/139 IEE Programme)</p> <p>BioEnergy Farm - the aim of this project is to increase the use and production of bioenergy and biofuels by farmers. This objective will be achieved by means of the creation of scan tools (both on-line and off-line) that allow the assessment of the economic viability of bioenergy production in the farm (anaerobic digestion, energy crops, short rotation coppice, wood combustion). If the profitability and feasibility look good (both by a first on-line self assessment tool and by an off-line expert guided assessment tool), support for the implementation will be given, including the drafting of a business plan. This plan will help the farmer to obtain funds and to make an investment decision. (IEE Programme)</p>
<u>Standardisation and certification</u> issues	<p>BioGrace aims <u>to harmonise calculations of biofuel greenhouse gas (GHG) emissions</u> and thus supports the implementation of the EU Renewable Energy Directive (2009/28/EC) and the EU Fuel Quality Directive (2009/30/EC) into national laws. (IEE programme)</p>

	<p>PELLCERT The key objective of the project is to create and implement an ambitious and uniform certification system for pellets in Europe, called “ENplus”, which will be used both by the heat and the power markets, for intra European trade but also for imports. This will be achieved through an intensive consultation with stakeholders. In addition, procedures will be developed to certify the sustainability of pellet production and trade. (IEE/10/463 IEE programme)</p> <p>SolidStandards The aim of the project is to support the implementation of EU standards for solid biofuels through an extensive training programme in 11 EU countries and the implementation of the standards in selected companies. The feedback of solid biofuels industry players will be given back to CEN relevant Committees for improving the existing standards and contributing to future standards. (IEE/10/218 IEE programme)</p> <p>BIONORM II – Pre-normative research on solid biofuels for improved European standards. (FP6)</p> <p>EUBIONET III project aims to increase the use of biomass based fuels in the EU by boosting sustainable and transparent biomass fuel trade, securing the most cost efficient and value-adding use of biomass for energy and industry and identifying yet unexploited biomass fuels. Amongst others:</p> <ul style="list-style-type: none"> - Contribution to CN codes for wood pellets, to price index development for industrial wood pellets and wood chips and to CEN standards for solid biofuels. - Sustainability criteria for biomass fuels have been evaluated in co-operation with market actors. <p>(IEE/07/777 IEE programme)</p>
Promoting a market for <u>bioenergy carriers</u>	<p>SECTOR: Production of Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction</p> <p>By combining torrefaction with pelletisation or briquetting, biomass is converted into a high-energy-density commodity solid fuel or bioenergy carrier with superior properties in view of (long-distance) transport, handling and storage, and also in many major end-use applications (e.g., co-firing in pulverised-coal fired power plants, (co-)gasification in entrained-flow gasifiers and combustion in distributed pellet boilers or for biorefinery routes.</p> <p>The core of the project concerns the further development of torrefaction and densification technology for a broad biomass feedstock range including clean woody biomass, forestry residues, agro-residues and imported biomass. Production recipes will be optimised on the basis of extensive logistics and end-use testing. <u>The experimental work will be accompanied by extensive desk studies to define major biomass-to-end-use value chains, design deployment strategies and scenarios, and conduct a full sustainability assessment.</u> The results will be fed into CEN/ISO working groups and international sustainability forums. (FP7 ENERGY.2011.3.7-1: Development of new or improved sustainable bio-energy Carriers)</p>

	<p>BioBoost: Biomass based energy intermediates boosting biofuel production</p> <p>The BioBoost project concentrates on <u>dry and wet residual biomass and wastes as feedstock for de-central conversion by fast pyrolysis, catalytic pyrolysis and hydrothermal carbonisation to the intermediate energy carriers oil, coal or slurry</u>. Based on straw the energy density increases from 2 to 20-31 GJ/m³, enabling central GW scale gasification plants for biofuel production. <u>A logistic model for feedstock supply and connection of de-central with central conversion is set up and validated allowing the determination of costs, the number and location of de-central and central sites</u>. Techno/economic and environmental assessment of the value chain supports the optimisation of products and processes.</p> <p>(FP7 ENERGY.2011.3.7-1: Development of new or improved sustainable bio-energy Carriers)</p>
Better support measures for mobilisation of agricultural and forest biomass	Comparison of the efficiency of different existing public support schemes for biomass feedstock mobilisation at EU/National/Regional/Local levels
	Understanding motivations and decision making among forest owners in Europe as a basis for improved policy approaches

Notes:

- 1) R&D on food crops is not in the scope of this overview.
- 3) Only projects of substantial size, which have direct link to biomass feedstocks are retained.
- 4) This overview does not cover R&D on algae as the growing of algae is directly linked with the conversion process, so this activity is better analysed under the core activities of the EIBI.
- 5) Waste to biogas is not a priority for the EIBI and that is why organic waste and biogas issues are not covered in this overview.
- 6) Some ERC grants are included but Marie Curie fellowships are not as they are usually of quite a small size.
- 7) The classification of projects is at most indicative as projects often cover different are